Program Management Plan

Checkout and Launch Control System (CLCS)

84K00050

It is the responsibility of each of the signing parties to notify the other in the event that a commitment cannot be met, and to initiate the timely renegotiation of the terms of this agreement

Agreements:

_____	_____
Project Manager, CLCS	Date
_____	_____
Director of Shuttle Processing	Date
_____	_____
Chairman, CLCS PMC	Date
_____	_____
Manager, Shuttle Program	Date

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PROGRAM MANAGEMENT PLAN

CHECKOUT AND LAUNCH CONTROL SYSTEM (CLCS)

1.0 INTRODUCTION

The current Launch Processing System (LPS) supporting the Shuttle Program is 1970's technology. It suffers from reliability and obsolescence problems and has serious expansion limitations. The Checkout and Launch Control System (CLCS) will replace the current Launch Processing System (LPS) with state-of-the-art technology. Best products from industry and government agencies will be combined to provide a showcase CLCS at the Kennedy Space Center.

An LPS Upgrade Review Team was formed in April 96 which resulted in a recommendation to provide a new LPS where the strategies emphasized were to 1) leverage technology and products, 2) re-engineer the applications software, and 3) employ rapid development (build a little, test a little).

A Level III CCBD issued in mid June 96 authorized a 60 Day Pilot Project dubbed New LPS (NLPS) . The 60 day analysis produced a *Management and Technical Volume* and a *Cost Volume* which together identify the Project Baseline.

In October 96, the project received start-up funding, enabling the team to move out on, the project's first delivery due in March 1997. In November, the project officially became known as CLCS. A Change Request (CR) was approved in December to provide funding for the entire five year effort.

The main purposes of this Program Management Plan are to:

- Establish Program objectives
- Establish Program-level requirements
- Establish management organizations responsible for the program throughout its life cycle and
- Establish Program-level resources, schedules, and controls

CLCS is a NASA-managed, re-engineering activity, with contractor support provided under existing NASA contracts. the Space Flight Operations Contract (SFOC), the Mission Support Contract (MSC), the Engineering Support Contract (ESC), the Base Operations Contract (BOC), and the Payload Ground Operations Contract (PGOC).

CLCS has an aggressive, success driven, product oriented, five-year schedule with deliveries to the end user every six months. Each incremental delivery provides an additional system capability that is built on top of the previously delivered capabilities.

2.0 PROGRAM OBJECTIVES

Although Kennedy Space Center is already designated as NASA's Center of Excellence for Launch and Cargo Processing Systems, continuing business as normal is not acceptable in an age when resources are scarce. In parallel with the *NASA Strategic Management Handbook* to do things better and for less cost, CLCS is more than a replacement of 20+ year old hardware to reduce O & M costs and obsolescence problems. The primary goal of the CLCS project is to redefine the Space Shuttle processing environment to improve checkout efficiencies. The CLCS Project will require complete review of the functional requirements of hardware, system software and end user application software. This includes a thorough examination of our culture and the way in which we are accustomed to processing vehicles and payloads. The preliminary analysis phase has already identified several key areas where operational efficiencies can be achieved, changes to today's process that cannot be readily implemented due to the limitations of the existing hardware. As the Shuttle Program embraces "change for efficiency", CLCS will provide an adaptable platform to implement critical and necessary process enhancements, as well as provide the ability to support Shuttle upgrades and future advanced launch systems.

As the *NASA Strategic Management Handbook* also stresses the communication, sharing, and transfer of information, the CLCS plan includes merging the multiple data sources in existence today into one central data resource which can easily be distributed to other NASA centers and beyond. This capability will support the fulfillment of NASA's goal to enhance the Space Operations Services to its customers during the mission preparation and flight execution phases.

The CLCS Project follows many of the "Critical Success Factors" as defined in *The Strategic Plan* for *NASA's Enterprise for the Human Exploration and Development of Space*. These include:

- Decreasing Space Shuttle costs and improving the management and operations of the integrated government/contractor team;
- Achieving dramatic reductions in the cost of space flight;
- Maintaining a skilled and motivated workforce;
- Maintaining high ethical practices and respecting the human and civil rights of our workforce and our partners.

3.0 PROGRAM LEVEL REQUIREMENTS

The need for an automated launch processing system at KSC evolved from the Shuttle Transportation System (STS) requirements that included the need for rapid launch turnaround to meet the projected launch rate and program economic objectives. In June 1972, after analysis of Shuttle processing requirements, the LPS concept, which led to the present Launch Processing System (LPS) configuration, was baselined. Design of LPS was completed in 1976 followed by Firing Room integration and applications software development.

KSC has successfully used LPS since the early 1980s for the Shuttle operations. However, the system lacks modern computing capabilities, uses an archaic custom programming language, and requires numerous patch-in, subsystem add-ons to maintain its capabilities with changing mission requirements.

KSC is recognized as world class in the area of manned launch and payload processing and is home to the Space Shuttle fleet. KSC's major products and services for NASA and its customers include the preparation, test, and checkout of launch systems, spacecraft, payloads, and experiments for launch. This includes coordinating a well-planned countdown to assure mission safety and success in launch and landing recovery operations, to assure that postlaunch space hardware can return for evaluation, refurbishment, repair, and servicing, and can be readied for another flight. With continually increasing maintenance costs and obsolescence problems, as well as lack of system flexibility and capability to incorporate needed Shuttle processing efficiencies, an LPS Upgrade Review team was chartered in April of 1996. The team studied the present system and made recommendations for an upgrade by establishing project concepts and documenting projected benefits for NASA and the Space Flight Operations Contractor (SFOC), the new ground and in-flight operations contractor. By increasing the system reliability and reducing the hardware, software code lines, and facility space, the team projects a yearly operational cost savings of 50% once the new system is fully deployed. In addition. the team predicts a decrease in the number of processing engineers required on site for each operation and a more efficient use of required operations/process engineering personnel.

The CLCS Project dictates various focuses to minimize risk. These include having the user's actively involved (NASA and SFOC), and maximizing on technology and information transfer from the Air Force's launch facilities and NASA Johnson Space Center's Mission Control regarding upgrade experiences. In addition, the project will focus on COTS and industry standards, and will challenge any requirements which preclude such a focus. The CLCS Project must be developed and brought on-line without any negative impacts on the STS manifest. To achieve this, the team will make small subsystem deliveries every six months and implement a well planned transition strategy allowing for the reuse of existing facilities.

CLCS is required to be compatible with and pose no impact to existing flight elements and GSE. A review will be conducted prior to the first complete CLCS Shuttle processing flow, to provide this assurance.

4.0 PROGRAM ELEMENTS AND ORGANIZATIONAL RESPONSIBILITIES

CLCS is a KSC NASA-managed activity, with contractor support from existing NASA contracts; the Space Flight Operations Contract (SFOC), the Mission Support Contract (MSC), the Engineering Support Contract (ESC), the Base Operations Contract (BOC), and the Payload Ground Operations Contract (PGOC). Using these existing multiple contracts to support the project provides flexibility which enables the project's management to capitalize on a wide range of available skills, experience which is critical to the project's success. The main intent here is to have the customer involved in the project throughout its life-cycle and to take advantage of technology and information transfer from other recent related technology upgrade activities.

4.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

Figure 4.1-1 illustrates the CLCS organization structure.

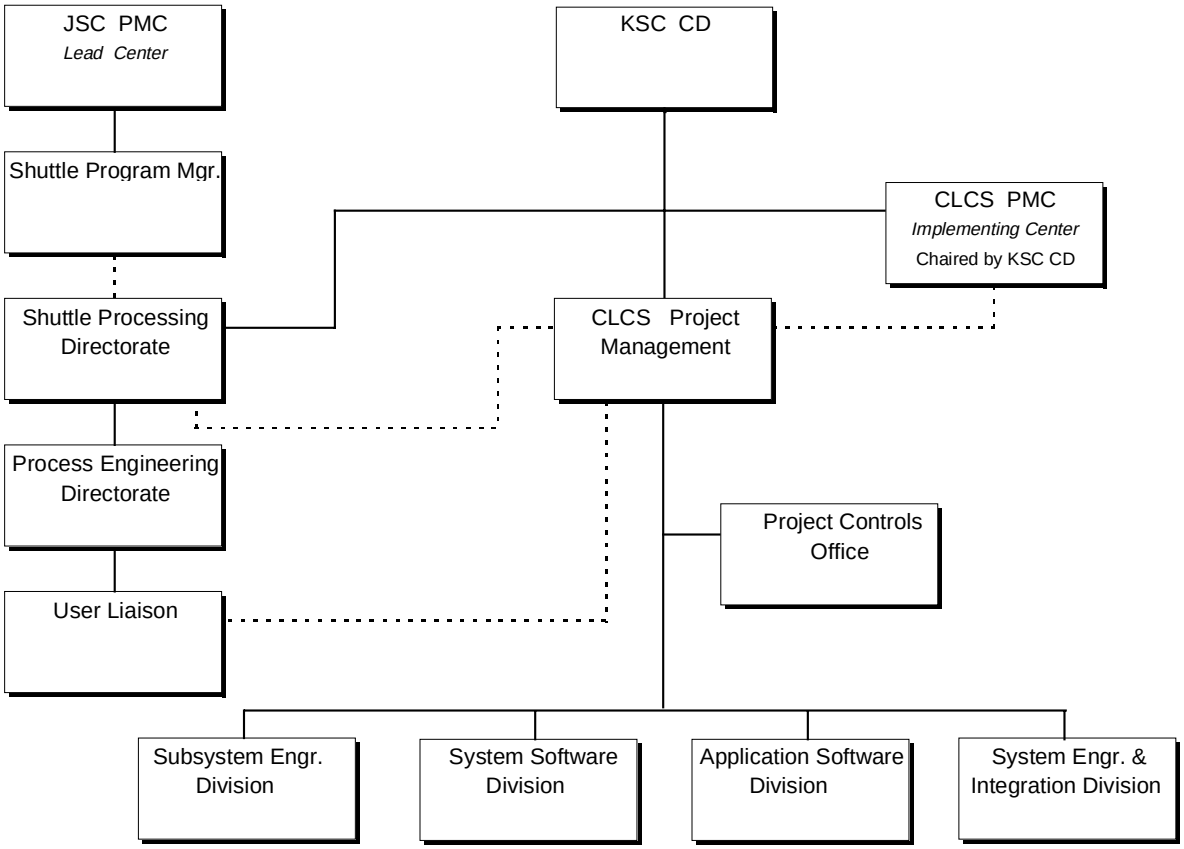

Figure 4.1-1 CLCS Organization Structure

4.1.1 Shuttle Program

The CLCS Project is funded by and operates under the auspices of the Space Shuttle Program (SSP). The SSP Manager, representing the Lead Center PMC, receives information and status on the CLCS Project on a periodic basis (quarterly or as requested by Program Manager) reflecting the technical and cost progress of the project. It is intended that the reporting of CLCS status and issues will be weaved into existing programmatic processes. The SSP Manager also approves Change Requests (CRs) for the project where new requirements have the potential to impact budget or schedule.

Funding for CLCS is carried as a Launch Support Equipment (LSE) line item under the responsibility of KSC's Director of Shuttle Processing.

4.1.2 CLCS Project Management Council (PMC)

The Implementing Center PMC consists of several members of KSC and JSC upper management who represent many dedicated years of experience in guiding and directing NASA in the achievement of its goals and mission. This organizational element is chartered to provide expertise and sound judgment on high level CLCS issues and will monitor the overall progress of the project relative to budget, schedule, and performance. They will also provide guidance, as required, so as to assure that CLCS fulfills the overall NASA mission. The CLCS PMC is chaired by KSC's Center Director. Other members are as follows: Deputy Director, KSC, Associate Director, Shuttle Upgrades (KSC), Chief, Information Office (KSC), Director of Shuttle Processing (KSC), Director of Engineering Development (KSC), Director of Logistics Operations (KSC), Director of Safety and Mission Assurance (KSC), Director of Payloads Processing (KSC), Director of Installation Operations (KSC), Chief Financial Officer (KSC), Director of Space Operations (JSC), and Project Manager, Checkout and Launch Control System Office (KSC).

4.1.3 Project Management

The NASA Project Manager and Deputy Project Manager are responsible for the overall management of the CLCS Project and have accepted the responsibility to ensure that the CLCS Project is implemented in the most expeditious and cost-effective manner. They have the authority to approve principal project documents, contract and performance reports, control room transition strategy and priority, and content for upper level status briefings.

4.1.4 Project Controls Office

Project Controls will work with System Engineering and Technical Integration to provide direct support to the NASA Project Managers. The Project Controls organizational element is responsible for project level plans, processes, and schedules, budget actions, Information Technology (IT), and Buy Plans, procurements, contract management, facility readiness, network administration, personnel training, project level and production configuration management, non-technical integration, project and contractor performance measurement/reporting.

4.1.5 System Engineering and Integration Division

System Engineering and Integration will work with Project Controls to provide direct support to the NASA Project Managers. The System Engineering and Integration organizational element is responsible for project level strategic planning and coordination, system level hardware, software, platform, and network architecture planning, development, and implementation, system level

requirements capture, reliability and maintainability analysis and engineering, logistics engineering support planning, coordination, and integration, security engineering, pre-production configuration management, integration and test certification plans, and the coordination of technology studies and synergy.

4.1.6 User Liaison

User Liaison will represent the User Community to assure that CLCS will meet the necessary requirements to fulfill KSC processing and launch mission. This organizational element will remain part of the Shuttle Processing Directorate and is responsible for: definition and collection of User's Functional Requirements (includes Shuttle, Ground Support Equipment (GSE), Complex Control System (CCS), and Payloads), defining and performing user test plans, evaluating, certifying, and validating CLCS hardware and software products, identifying transition users' requirements and operational impacts, defining Human Computer Interfaces, ensuring accurate implementation of application software design requirements, integrating users inputs into delivery and facility schedules, identifying impacts to Operations and Maintenance Instructions (OMIs) and other documentation, and identifying and coordinating users' training requirements.

4.1.7 Subsystem Engineering Division

Subsystem Engineering is a development organizational element responsible the design, development, testing, and delivery of CLCS gateways, consoles, platforms, safing subsystem, networks and other interfaces. Subsystem Engineering will support Project Controls by providing schedule, budget, training, and procurement inputs as required. Subsystem Engineering will work closely with System Engineering and Integration providing input to system architecture and delivery planning and coordination as required.

4.1.8 System Software Division

System Software is a development organizational element responsible for the design, development, testing, and delivery of system software services that allow CLCS to operate. These services provide the mechanism for user applications, unique system programs and software development tools to run on CLCS. System Software will support Project Controls by providing schedule, budget, training, and procurement inputs as required. System Software will work closely with System Engineering and Integration to provide input to system architecture and delivery planning and coordination as required.

4.1.9 Application Software Division

Application Software is a development organizational element responsible for the design, development, testing, and delivery of CLCS user application software. This includes establishing standards, guidelines, policies and procedures for programming, documenting, reusing, and developing application software with appropriate Control Boards, and Life-Cycle Methodology. Application Software will support Project Controls by providing schedule, budget, training, and procurement inputs as required. Application Software will work closely with System Engineering and Integration providing input to system architecture and delivery planning and coordination as required.

Application Software is also responsible for the design, development, testing, and delivery of simulation services. These services provide the mechanism for the creating, maintaining, testing, and

executing of math models and model control language and provide the common functions needed by CLCS to test and checkout hardware/software functionality.

4.2 CIVIL SERVICE LABOR

The CLCS Project will be led and staffed with KSC Civil Service Labor from the Engineering Development (DE), Shuttle Processing (PH), Payload Processing (BB), Logistics Operations (LO), and Safety and Mission Assurance (EC) Directorates. Project Management, planning, and engineering will be led by civil servants. Civil servants will do hands-on development in the hardware, software, system and facility design.

4.3 CONTRACTOR LABOR

The CLCS Project will require support from existing NASA contracts in the following areas:

- **SFOC** NAS9-20000 The Space Flight Operations Contract will provide Shuttle systems expertise, requirements, test and validation, facility modifications, training, application development and procurement support.

- **MSC** NAS9-18300 The Mission Support Contract will provide expertise on the JSC Mission Control Center (MCC) designs and potential reuse of government-owned designs and products selected from the MCC systems.

- **ESC** NAS10-11943 The Engineering Support Contract will provide development labor and expertise where sufficient resources and/or skills are not available within Civil Service.

- **PGOC** NAS10-11400 The Payload Ground Operations Contract will provide payloads systems expertise, requirements, test and validation, training, and application development support.

- **BOC** NAS10-12000 The Base Operations Contract will provide Complex Control Set systems expertise, requirements, test and validation, facility modifications, and training.

4.4 OTHER INTERFACES AND RESPONSIBILITIES

4.4.1 Space Station

No requirements for CLCS to support or interface with Space Station are defined at this time.

4.4.2 Space Operation Management Organization (SOMO)

The high-level architecture and functionality proposed for CLCS is similar to those architectures that exist or are being developed at other NASA and DOD Centers. In keeping with the charter for which SOMO was organized, to promote synergy and commonality across the development and operations of the different NASA Centers (thus reducing overall project costs), the CLCS Project envisions utilizing SOMO as a resource for information on CLCS-like Projects at those other Centers. In addition, CLCS Management and Engineering personnel will provide CLCS design and implementation information to the SOMO organization for retention in the SOMO Information Database and for analysis for commonality within the Agency.

In order to accomplish these technical communications, the CLCS Project will appoint a SOMO Liaison from the Project to interface with the designated SOMO representative(s) on a periodic basis. In addition, the designated SOMO representative(s) will be advised of and invited to the various Project Planning and Design Reviews where overall system Operations Concepts and architectural designs will be presented.

Based on SOMO recommendations, CLCS Project personnel will support attendance at other NASA Center design reviews to assist in the “search for synergy” across the other agency projects.

4.4.3 Non-Advocacy Review (NAR)

CLCS will support the NAR team in it’s independent assessment of the CLCS project and will incorporate/implement findings, issues and concerns as directed.

5.0 PROGRAM RESOURCES

The CLCS Project will utilize both Civil Service and contractor resources as identified in Figure 5.0-1 below. Although modifications to existing facilities will be required, the CLCS project has developed viable transition plans enabling the project to avoid the construction of any new facilities.

“NASA Procurements" in Figure 5.0-1 represents non-labor and includes hardware and software buys, facility modifications, and training and travel. Approximately $100K has been allocated annually for travel while an average of $700K has been set aside yearly for training.

	FY97	FY98	FY99	FY00	FY01	FY02	Total
Labor (FTE)	**166**	**344**	**403**	**329**	**179**		**1421**
Contractor	**100**	**249**	**283**	**209**	**89**		**930**
Civil Service	**66**	**95**	**120**	**120**	**90**		**491**
Contractor Cost	**$10.0**	**$25.6**	**$30.0**	**$22.8**	**$10.0**		**$98.4**
USA	**3.2**	**7.6**	**11.5**	**11.8**	**8.1**		**42.2**
LMSMS	**4.8**	**12.3**	**12.0**	**5.4**	**0.5**		**35.0**
I-NET	**1.8**	**4.9**	**5.1**	**4.2**	**0.6**		**16.6**
EG&G	**0.1**	**0.4**	**0.7**	**0.7**	**0.4**		**2.3**
MDS&DS	**0.1**	**0.4**	**0.7**	**0.7**	**0.4**		**2.3**
NASA Procurements	**$11.7**	**$14.8**	**$21.1**	**$15.4**	**$10.0**		**$73.0**
Total Cost (excl. CS)	**$21.7**	**$40.4**	**$51.1**	**$38.2**	**$20.0**	**$0.0**	**$171.4**
APA	**$0.0**	**$0.0**	**$0.0**	**$8.0**	**$14.0**	**$12.3**	**$34.3**

Costs Include:
Initial Spares
HW/SW Maintenance
Development Environment
Labor @100K/WY w/3% escalation
LCC Facility Mods/CCMS Removal
Installation & Activation
SDC, SIM, & Models Deltas
OMI Rewrite
Re-Certification
RCVS Replacement
Training, Travel

Funding: Shuttle Launch Site Equipment Upgrades (UPN 260)

Figure 5.0-1 CLCS Resource Requirements

6.0 SCHEDULE

6.1 PROGRAM-LEVEL ACTIVITIES

The LPS Upgrade Review Team study (see section 1.0) served as the "Pre Phase A Advanced Studies" for the CLCS Project. The Go-ahead from this study initiated the 60 Day Pilot Project (see section 1.0) or "Phase A Preliminary Analysis". The primary products produced in Phase A were the *Management and Technical Volume* and a *Cost Volume* which together defined the project's baseline and included the description of the life-cycle approach, concept of operations, hardware and software architecture, implementation and transition plans, Work Breakdown Structure, ROM cost estimates, etc. Several reviews followed the completion of the 60 Day Pilot Project including an architectural baseline review and Basis of Estimate review (serving as the projects preliminary Non-Advocate Review) supported by key personnel from JSC's MCC project. Approval of start-up funding in October, 1996 initiated the "Phase B Definition" for CLCS.

CLCS has adopted the concept of incremental deliveries, i.e. ten small deliveries, one every six months. This approach ensures that the system is delivered, not paper/theory on what the system "should be". These six month drops are integral to the success and risk mitigation of the project. It allows for early detection of latent flaws, quick turnaround of system fixes, and provides early user review of the real system (not paper design). The results of this approach create an overlap among the remaining phases of the project's life-cycle as definition and design of one delivery will be concurrent with the development of another. In addition, CLCS replaces technology at over 10 different sites, several with their own unique requirements. Some deliveries will lead to sites becoming operational while other sites are entering previous phases.

MIL-STD-498 describes the development process and the reviewing techniques for both incremental and evolutionary type projects. CLCS represents a hybrid of these two types of projects. CLCS will meet the intent of and tailor appropriately the reviews discussed in MIL-STD-498 through system level and project level reviews and in particular the design panel process.

The Architectural Baseline Review (ABR) will establish the baseline for system level specifications and requirements will also serve as the baseline mechanism for many project level documents. Annual Project Plan Reviews (PPRs) clarify and review significant changes to system baseline requirements, assure changes are to be implemented efficiently, and assure changes support the project's critical milestones as identified in the CLCS Five Year Master Project Schedule. Preliminary and Critical Design Reviews (PDR and CDR) will be conducted prior to major system procurement activities.

Prior to the first complete CLCS Shuttle processing flow, a review will be conducted to provide the assurance that CLCS has no impact to flight elements.

Figure 6.1-1 illustrates the CLCS Project Life-cycle and the incremental deliveries.

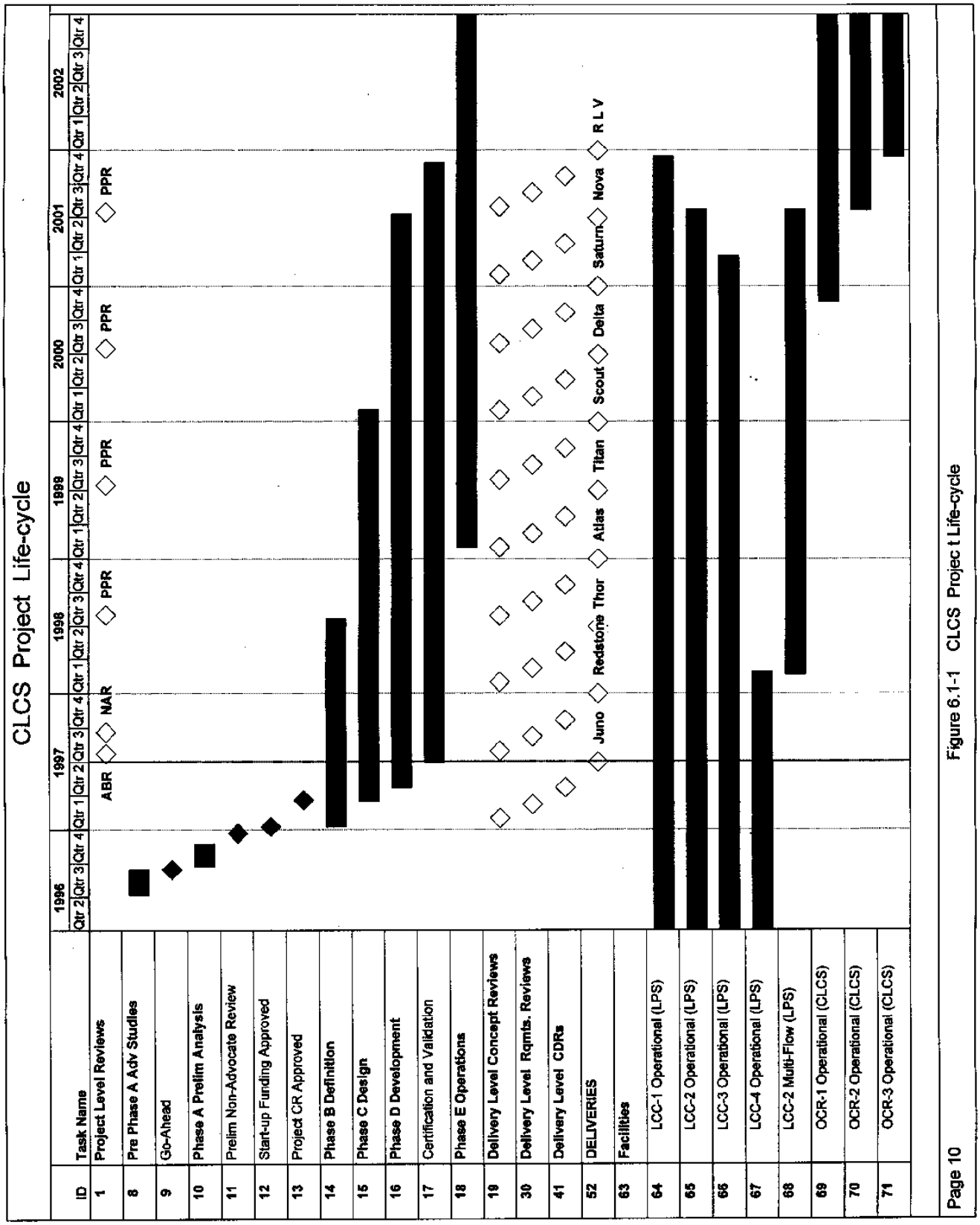

Figure 6.1-1 CLCS Project Life-cycle

6.2 DELIVERY AND CAPABILITY

A delivery manager is assigned to each delivery. This delivery manager is responsible for collecting status and identifying issues and concerns to the CLCS project management. Each delivery is critical to the next as they serve as building blocks, each bringing additional capability with CLCS being launch capable in December 2000 and fully implemented by October 2001. Other milestones include orbiter power-up capability in March 1999 and orbiter pre-launch processing in September 2000. The five year delivery schedule is illustrated in Figure 6.3-1.

Each incremental delivery has its own design, development, and implementation process which closely resembles the typical project life-cycle. Each delivery is made up of multiple products which when integrated together provide system capabilities. Each product is required to have three design panels which serve as System Requirements Reviews (SRRs), PDRs, and CDRs.

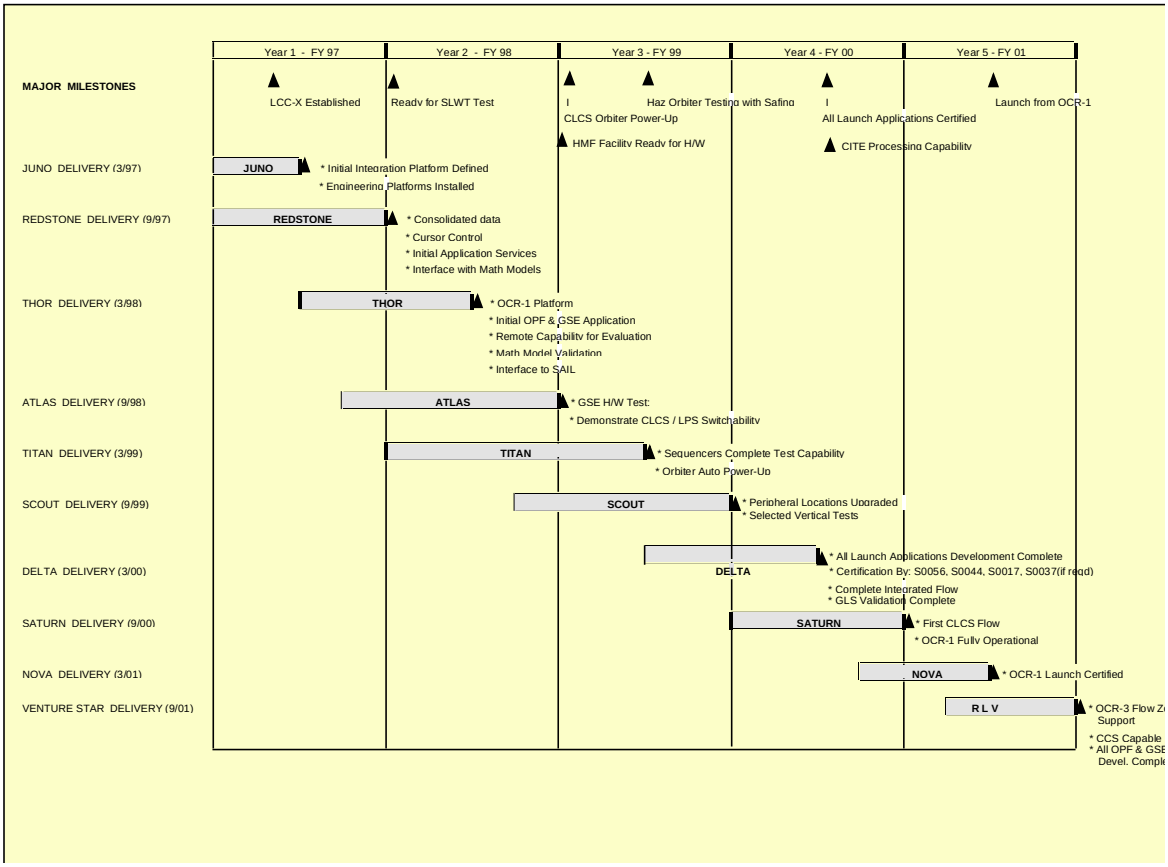

Figure 6.2-1 CLCS 5-Year Delivery Schedule

7.0 CONTROLS

7.1 VERIFICATION OF REQUIREMENTS - CERTIFICATION

Although CLCS is replacing an existing system where requirements are well defined, the CLCS team will work diligently to challenge and separate real requirements from 20 years of cultural influences, thus minimizing the complexity of design, ensuring that COTS products can be implemented into the CLCS design, and allowing for greater flexibility and creativity in the fulfillment of the "real requirements". A control board, composed of project management and the user community, will manage and control changes.

Involvement of the user community is critical to the success of the CLCS project and therefore this involvement will be part of each phase of each incremental delivery. The user community is responsible for developing, approving, and performing the test plans for the verification, validation, and certification of CLCS. Figure 7.1-1 illustrates the steps of this process. This process will ensure full compliance to system requirements.

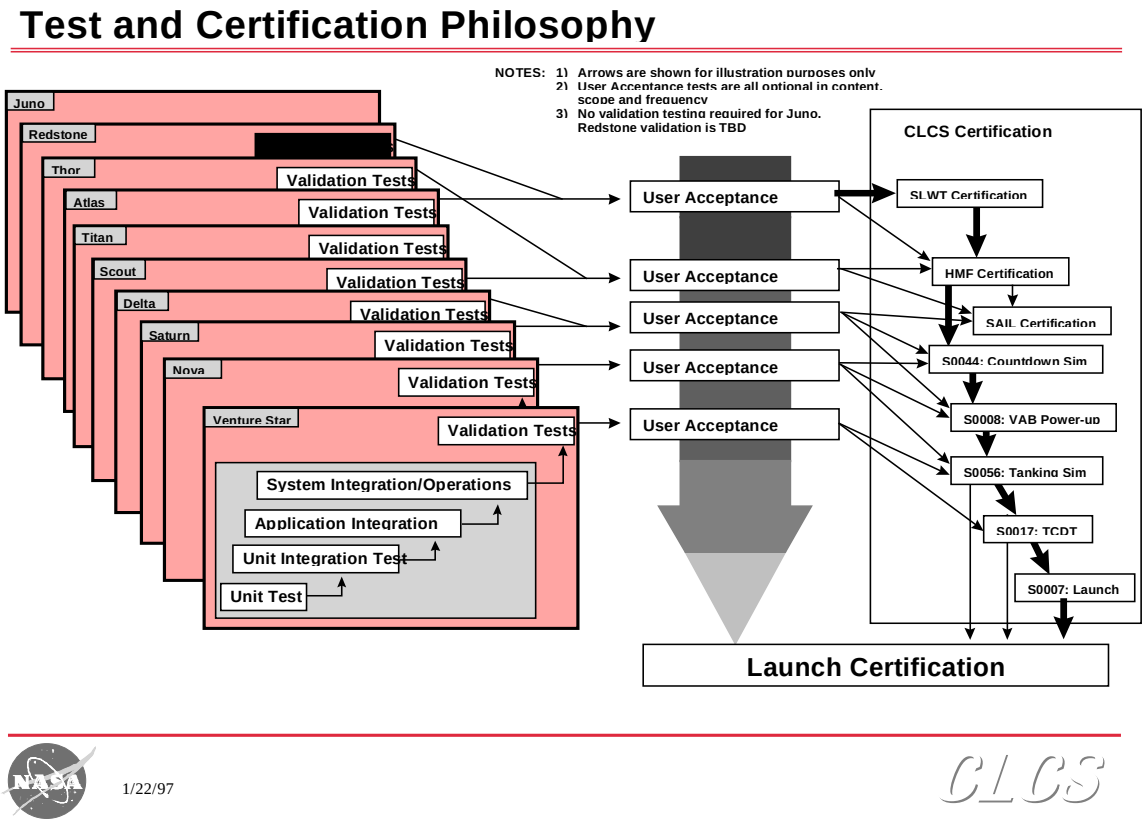

Figure 7.1-1 CLCS Test and Certification Process

7.2 KEY PROGRAM PARAMETERS

Cost and schedule data will be analyzed against two sets of planning data. 1) In-depth project planning was performed by the Initial 60-Day Team. The resulting data has been used to establish the project's cost and schedule baseline. 2) The system being developed by this project will evolve from incremental deliveries. These deliveries are intended be made approximately one every six months over the five year period, totaling 10 deliveries. Each delivery will have its own mini design, development, and implementation cycle. During the "kick-off" of each delivery cycle, detailed delivery planning will be performed, updating cost and schedule plans accordingly. This revised plan will serve as updates to the baseline for cost and schedule performance analysis.

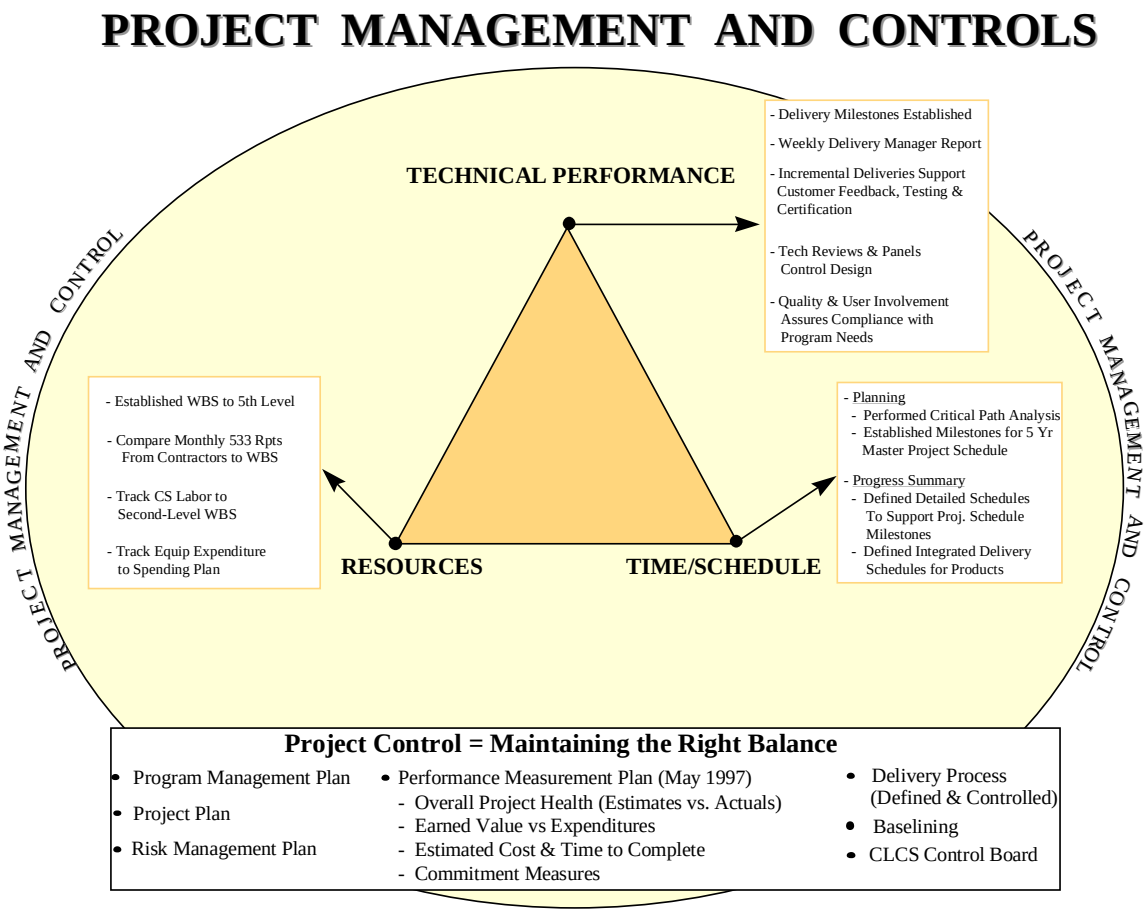

Figure 7.2-1 CLCS Management and Controls

Figure 7.2-1 illustrates the relationship between technical performance, resources, time/schedule, and management and controls. Additionally, this figure lists the major tools to be used in order to maintain the correct balance among these elements. Beginning with the second delivery, September 1997, the CLCS Performance Measurement Plan will be used to assess cost, schedule, and technical performance. This data will be made available to the CLCS Program Management Council (PMC) and the Manager, Space Shuttle Program and will serve as a tool to inform these elements on issues

of the project's overall performance. The Performance Measurement Plan will also identify and establish measurements to monitor the progress towards achieving the commitments described in the Program Commitment Agreement (84K00007). Any significant change to the project's cost, schedule or technical content will require an update to the PCA. The CLCS PMC will judge the significance of changes of the project's key parameters.

7.3 ALLOWANCE FOR PROGRAM ADJUSTMENT (APA)

A 20% APA has been established for the CLCS Project. Current budgetary phasing has the APA distributed over FY00 through FY02 (see Figure 5.0-1)

END